

ALGAL STATUS INDEX

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The Algal Status Index focuses on the changes in percentage of certain algae in response to increasing siltation. This index is an example of a variety of structural and functional characteristics of algal communities that have been successfully used to assess water quality (Lowe and Pan 1996; McCormick and Cairns, 1994). Indices based on autecological characteristics of algal species are most often employed to monitor pollution in surface waters throughout the world [autecological information is defined as available ecological information about each species, including physical, chemical, and pollution tolerances]. Information on ecological preferences of river algae is available for some regions of the U.S. (Cuffney and others, 1997; Lowe, 1974; Stevenson and Pan, 1999; Barbour and others, 1999; Charles, 1996) and can be used to estimate water quality in nearby Study Units with similar ecological characteristics. Although no autecological indices have been developed for application to U.S. rivers on a national scale, 'simple' measures based on structure of algal communities can be useful in comparing algal communities among different land uses and different basins.

The Algal Status Index (sometimes called a siltation index) is the relative abundance of motile diatoms—*Navicula*, *Nitzschia*, *Cylindrotheca*, and *Surirella*—in a sample of periphytic diatoms. These diatoms are able to move between silt particles and live in association with fine sediments (that is, they are "epipelic"). Because they are able to avoid being buried, they are considered more tolerant of sedimentation than other diatoms. This index has been used to detect siltation in Montana rivers (Bahls and others, 1992). Siltation index values can be high due to natural prevalence of fine sediments at sampling sites, including depositional areas of most rivers, and the majority of habitats in most slow rivers. Excessive siltation in high-gradient stony rivers, on the other hand, is most probably caused by soil erosion and likely does indicate a water-quality problem. Nationally, this index has a tendency to be higher in agricultural sites and lower in undisturbed sites. As defined, the index is weighted heavily by the occurrence of *Navicula* and *Nitzschia* species. Some of these taxa are epipelic, but more importantly, many of these taxa are indicative of ("tolerant to") nutrient and/or organic enrichment (e.g., van Dam and others, 1994).

This index was calculated for 863 periphyton samples collected in 16 Study Units from 1995 to 1997 (for field methods, see Porter and others, 1993). Metric values and percentage ranking for individual samples were calculated for

all available 545 Richest Targeted-Habitat (RTH) samples, and all available 318 Depositional Targeted-Habitat (DTH) samples. The richest targeted habitat is the instream habitat type that supports the taxonomically richest assemblage of organisms within a sampling reach; examples include a riffle in a shallow, coarse-grained, high-gradient stream or snag habitats in a sandy-bottom stream (Porter and others, 1993). The depositional targeted habitat is typically an organically rich, depositional area such as a pool (Porter and others, 1993).

For comparison of results among all sites at a national scale, median values and percentage rank were calculated for 140 sites. All taxonomic groups (fish, benthic invertebrates, and algae) were sampled at those sites, and basic ancillary information was available for all sites.

Non-parametric correlation analysis was used to find out how algal metrics were related to environmental conditions. Environmental variables used in this analysis were: elevation (ft); drainage area (km²); population density in the basin for 1990; percent of basin in agricultural, urban, rangeland, and forest land use; and flow-weighted concentration of nutrients (ammonia nitrogen, nitrate + nitrite, total nitrogen, orthophosphate, total phosphorus). Box plots were used to compare metric values among:

- two types of habitat: depositional (DTH samples) and erosional (RTH samples),
- three watershed size classes: small (<500 km²), middle (between 500 and 5000 km²), and large (> 5000 km²),
- eighteen level II ecoregions (Omernik),
- five land-use categories: agricultural, urban, undeveloped, mining, and mixed land use.

The Algal Status Index was one of 15 algal metrics calculated for all sites; national-scale comparison of these metrics revealed a major gradient from agricultural sites to undeveloped (relatively clean) and mining sites. The Algal Status Index was one of the best metrics to identify water-quality problems caused by agricultural land use; high values of this index can indicate soil erosion. Care should be taken to exclude other possible reasons for elevated values of this metric, such as natural presence of fine sediments, large watershed, etc. Other metrics, especially high biovolume of green algae and total algal biovolume, can also be used to show effects of increased nutrient loading on river ecosystems. Effects of mining can be linked to high percent of *Achnanthes minutissima*. Toxic substances can cause low algal biomass and low diversity in some mining and urban sites. Autecological characteristics of dominant algal species may greatly help to recognize specific problems as acidification, salinization or organic pollution. Information on ecological preferences of many common algal

species may be found in Sladeczek (1973), Lowe (1974), van Dam et al. (1994), and Lange-Bertalot (1979).

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